Size-based models for assessment of sea scallops (*Placopecten magellanicus*)

TOR 1Modeling Approaches

NOAA FISHERIES
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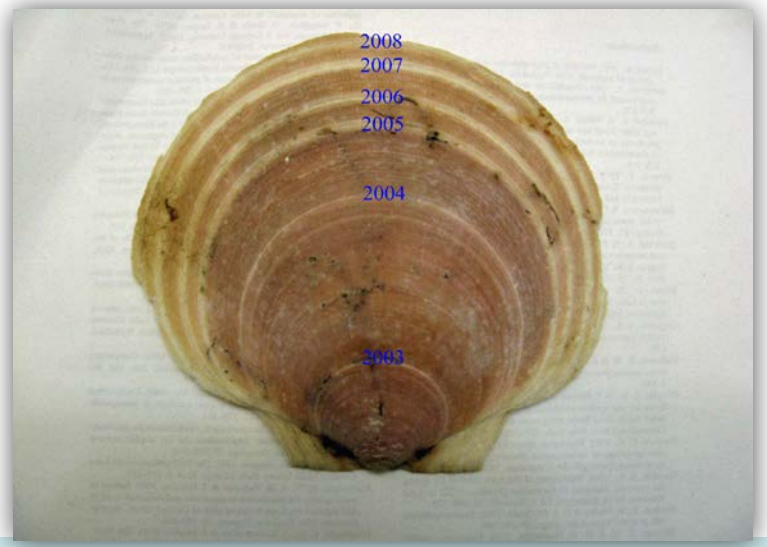
May 19, 2014

Why sized-based?

Have survey and commercial shell heights, but only shells from the survey, so not possible to get commercial ages

Shell rings are laid down annually, but the ring from first year or years typically missing or obscure, especially for larger scallops, so getting absolute age is difficult

Use growth increments between rings to develop stochastic growth matrices



Stochastic growth matrices

Based either directly (non-parametrically) on shell increment data or by fitting von Bertalanffy curves to the shell increment data, with variability among individuals modeled as random effects - methods give similar results

All NEFSC scallop assessment models use stochastic growth matrices

	42	47	52	57	62	67	72	77	82	87	92	97	102	107	112	117	122	127	132+
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62	0.03	0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67	0.05	0.03	0.04	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
72	0.12	0.11	0.07	0.05	0.03	0	0	0	0	0	0	0	0	0	0	0	0	0	0
77	0.35	0.25	0.12	0.11	0.09	0.06	0.02	0	0	0	0	0	0	0	0	0	0	0	0
82	0.31	0.34	0.24	0.13	0.16	0.14	0.06	0.03	0	0	0	0	0	0	0	0	0	0	0
87	0.14	0.19	0.29	0.23	0.18	0.22	0.18	0.12	0.05	0	0	0	0	0	0	0	0	0	0
92	0.01	0.04	0.17	0.27	0.21	0.24	0.29	0.25	0.13	0.09	0.01	0	0	0	0	0	0	0	0
97	0	0.01	0.04	0.15	0.2	0.19	0.21	0.29	0.28	0.19	0.11	0	0	0	0	0	0	0	0
102	0	0	0.01	0.06	0.09	0.12	0.17	0.18	0.32	0.32	0.25	0.17	0.01	0	0	0	0	0	0
107	0	0	0	0	0.03	0.03	0.04	0.09	0.16	0.28	0.32	0.32	0.2	0.01	0	0	0	0	0
112	0	0	0	0	0	0.01	0.02	0.03	0.05	0.1	0.24	0.27	0.36	0.3	0.03	0	0	0	0
117	0	0	0	0	0	0	0	0	0	0.02	0.06	0.17	0.25	0.39	0.35	0.03	0	0	0
122	0	0	0	0	0	0	0	0	0	0	0.01	0.06	0.14	0.22	0.4	0.48	0.05	0	0
127	0	0	0	0	0	0	0	0	0	0	0	0	0.03	0.07	0.17	0.37	0.51	0.09	0
132+	0	0	0	0	0	0	0	0	0	0	0	0	0	0.02	0.05	0.12	0.45	0.91	1

CASA (Catch At Size Analysis) Model

Assessment estimation model based loosely on Sullivan et al. 1990

Appropriate for sea scallops (abundant commercial and population shell height data, growth increment data)

Forward-projecting statistical catch at size model similar to SCAA models

Pure size-based model – internally tracks shell heights

Programmed in ADMB – used for assessments since 2007

Tunes to survey trends, survey and commercial shell heights, commercial landings. Also uses priors on survey efficiencies

Mid-Atlantic and Georges Bank modeled separately – in current assessment, Georges Bank split into open and closed area models

Scallop Area Management Simulator (SAMS)

Size (shell height) and area structured forecasting methodology

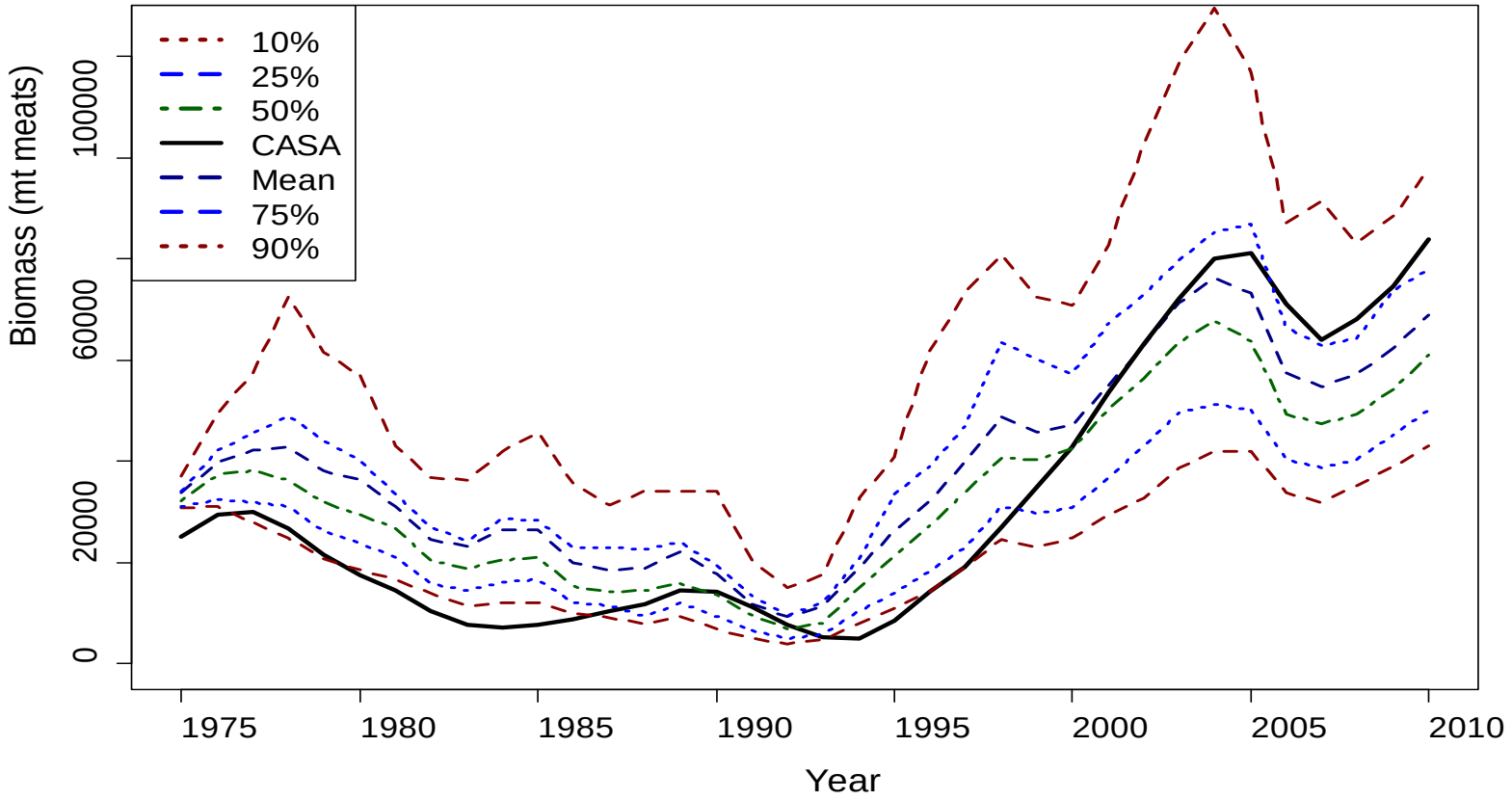
Resource divided into a number of smaller regions and subareas (2 regions, 16 subareas currently)

Area specific mortality, growth etc. – allows for simulation of area management such as rotational and long-term closures

Recruitment simulated stochastically based on recruits observed in the NEFSC dredge survey in each area

Programmed in Fortran-90. Versions of this model have been used to aid management decisions since 1999

Testing SAMS vs CASA: Current configuration of SAMS was initialized to 1975 GB data, given CASA-estimated fishing mortalities (open/closed) for 1975-2010, and then run for 36 years (1000 stochastic projections). No other CASA output was used in the SAMS run. Forecast fits observed CASA biomass estimates to appropriate accuracy



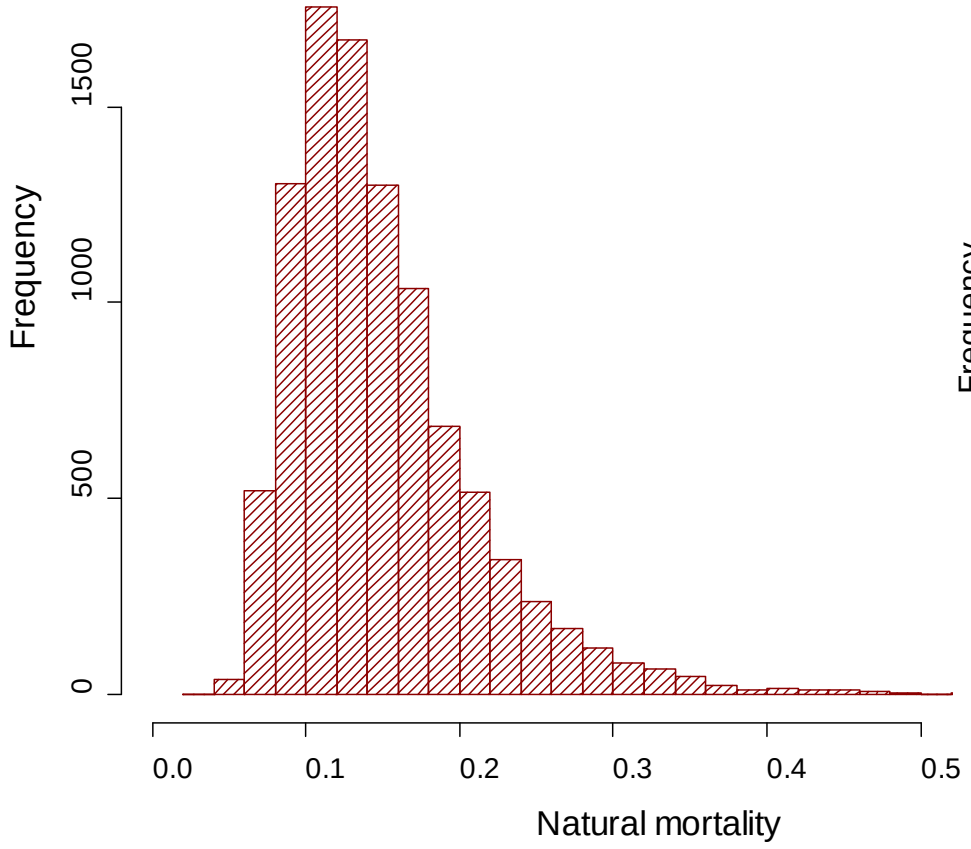
SYM model for estimating reference points

1. Uncertainties among model parameters (eg M, S-R parameters) is evaluated, taking into account correlation structure, when applicable

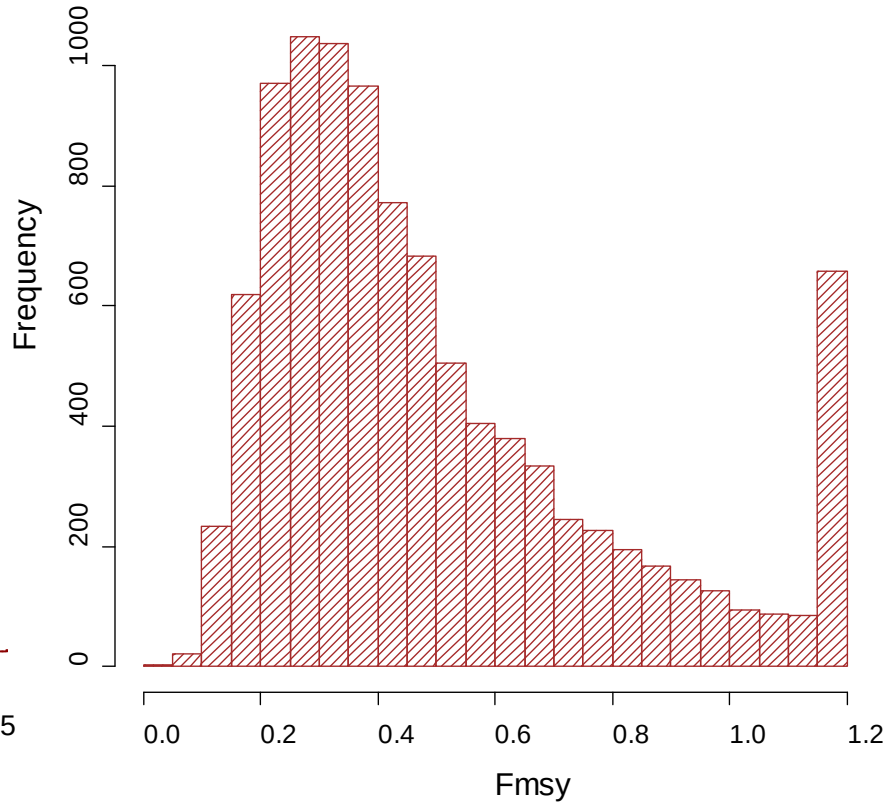
2. Reasonable probability distributions for each parameter are determined, based on (1)

3. Parameters are repeatedly drawn randomly from these distributions. For each draw, reference points such as F_{MSY} are estimated from YPR and stock-recruit relationships (point estimates and probability distributions). Confidence intervals for these reference points can then be constructed

Assumed distribution of natural mortality on Georges Bank



Calculated distribution of F_{MSY} on Georges Bank



Tradeoffs between expected yield and probability of overfishing gives systematic way of setting ABC/ACL

ABC set @ 25% chance of overfishing.

Loss of expected yield < 1%